CLAIMS

1. An extruder die for forming a preform for manufacture into an optical fibre, comprising:

a central feed channel for receiving a material supply by pressure-induced fluid flow;

flow diversion channels arranged to divert a first component of the material radially outwards into a welding chamber formed within the die;

a core forming conduit arranged to receive a second component of the material from the central feed channel that has continued its onward flow; and

a nozzle having an outer part in flow communication with the welding chamber and an inner part in flow communication with the core forming conduit, to respectively define an outer wall and core of the preform.

2. An extruder die according to claim 1, wherein the die is provided with pairs of mutually facing internal walls that form gaps extending between the core forming conduit and the welding chamber and allow fluid communication therebetween, the gaps being shaped to form struts supporting the core in the outer wall.

3. An extruder die according to claim 2, wherein the mutually facing internal walls incorporate at least one bend in order to increase the radial length of the struts.

4. An extruder die according to claim 2 or 3, wherein the internal walls have a radial length greater than the gap width.

5. An extruder die according to claim 4, wherein the radial length of the internal walls is greater than the gap width by a factor of one of: 2, 3, 4, 5, 6, 7, 8, 9, 10 and 20.

6. An extruder die according to any one of claims 1 to 5, wherein the outer part of the nozzle is shaped to provide a circular-section preform outer wall.

7. An extruder die according to any one of claims 1 to 5, wherein the outer part of the nozzle deviates from a circular shape so as to provide sections of preform wall interconnecting wall-to-strut junctions that are shorter than would be required to form a circular-section preform outer wall.

8. An extruder die according to any one of the preceding claims, wherein the outer part of the nozzle has a first dimension defining a wall thickness of the preform outer wall and wherein said first dimension is greater than said gap between the mutually facing internal walls that form the preform struts.

9. An extruder die according to claim 8, wherein said first dimension is greater than said gap by a factor of one of: 2, 3, 4, 5, 6, 7, 8, 9 and 10.

10. An extruder die according to any one of the preceding claims, wherein the inner part of the nozzle has a second dimension defining a core thickness of the preform core and wherein said second dimension is greater than said gap between the mutually facing internal walls that form the preform struts.

11. An extruder die according to claim 10, wherein said second dimension is greater than said gap by a factor of one of: 2, 3, 4, 5, 6, 7, 8, 9 and 10.

12. An extruder die according to any one of the preceding claims, wherein the flow diversion channels include a first group of the flow diversion channels which extend from the core forming conduit to the welding chamber.

13. An extruder die according to claim 12, wherein the flow diversion channels of the first group extend perpendicular to the core forming conduit.

14. An extruder die according to claim 12 or 13, wherein the flow diversion channels of the first group have a width dimension that is substantially constant in the feed direction.

15. An extruder die according to claim 12 or 13, wherein the flow diversion channels of the first group have a width dimension that reduces in the feed direction.

16. An extruder die according to any one of the preceding claims, wherein the flow diversion channels include a second group of the flow diversion channels that extend from the central feed channel to the welding chamber.

17. An extruder die according to claim 16, wherein the flow diversion channels of the second group extend obliquely to the central feed channel.

18. An extruder die according to any one of the preceding claims, further comprising a mandrel extending down the central feed channel into the core forming conduit with a dependent peg thereof so as to form a hollow core in the preform.

19. An extruder apparatus including a main body having a location for receiving an extruder die according to any one of the preceding claims, a space for arranging a billet of material above the extruder die and a force transmitting assembly for applying pressure to the billet to drive the material through the extruder die.

20. A method of forming a preform for manufacture into an optical fibre, comprising:

applying pressure to supply a material into a central feed channel of an extruder die by pressure-induced fluid flow;

diverting a first component of the material radially outwards into a welding chamber formed within the die;

allowing a second component of the material to flow onwards from the central feed channel into a core forming conduit in the die; and

dispensing the material through a nozzle having an outer part in flow communication with the welding chamber and an inner part in flow communication with the core forming conduit, to respectively define an outer wall and core of the preform.

21. A method according to claim 20, wherein the extruder die is provided with pairs of mutually facing internal walls that form gaps extending between the core forming conduit and the welding chamber and allow fluid communication therebetween, the gaps being shaped to form struts supporting the core in the outer wall.

22. A method according to claim 21, wherein the mutually facing internal walls incorporate at least one bend in order to increase the radial length of the struts.

23. A method according to claim 20 or 21, wherein the internal walls have a radial length greater than the gap width.

24. A method according to claim 23, wherein the radial length of the internal walls is greater than the gap width by a factor of one of: 2, 3, 4, 5, 6, 7, 8, 9, 10 and 20.

25. A method according to any one of claims 20 to 24, wherein the outer part of the nozzle is shaped to provide a circular-section preform outer wall.

26. A method according to any one of claims 20 to 24, wherein the outer part of the nozzle deviates from a circular shape so as to provide sections of preform wall interconnecting wall-to-strut junctions that are shorter than would be required to form a circular-section preform outer wall.

27. A method according to any one of claims 20 to 26, wherein the outer part of the nozzle has a first dimension defining a wall thickness of the preform outer wall

and wherein said first dimension is greater than said gap between the mutually facing internal walls that form the preform struts.

28. A method according to claim 27, wherein said first dimension is greater than said gap by a factor of one of: 2, 3, 4, 5, 6, 7, 8, 9 and 10.

29. A method according to any one of claims 20 to 28, wherein the inner part of the nozzle has a second dimension defining a core thickness of the preform core and wherein said second dimension is greater than said gap between the mutually facing internal walls that form the preform struts.

30. A method according to claim 29, wherein said second dimension is greater than said gap by a factor of one of: 2, 3, 4, 5, 6, 7, 8, 9 and 10.

31. A method according to any one of claims 20 to 30, wherein the flow diversion channels include a first group of the flow diversion channels which extend from the core forming conduit to the welding chamber.

32. A method according to claim 31, wherein the flow diversion channels of the first group extend perpendicular to the core forming conduit.

33. A method according to claim 31 or 32, wherein the flow diversion channels of the first group have a width dimension that is substantially constant in the feed direction.

34. A method according to claim 31 or 32, wherein the flow diversion channels of the first group have a width dimension that tapers down in the feed direction.

35. A method according to any one of claims 20 to 34, wherein the flow diversion channels include a second group of the flow diversion channels which extend from the central feed channel to the welding chamber.

36. A method according to claim 35, wherein the flow diversion channels of the second group extend obliquely to the central feed channel.

37. A method according to any one of claims 20 to 36, wherein the extruder die further comprises a mandrel extending down the central feed channel into the core forming conduit with a dependent peg thereof so as to form a hollow core in the preform.

38. A method according to any one of claims 20 to 37, wherein the material supplied to the central feed channel is a glass.

39. A method according to any one of claims 20 to 37, wherein the material supplied to the central feed channel is a polymer.

40. A method of manufacturing an optical fibre comprising:

forming a preform by extrusion according to the method of any one of claims 20 to 39; and

reducing the preform to an optical fibre.

41. A method according to claim 40, wherein reducing the preform to an optical fibre comprises reducing the preform to a cane followed by reducing the cane to the optical fibre.

42. A method according to claim 41, wherein reducing the cane comprises arranging the cane in a tubular jacket and reducing the cane and tubular jacket into the optical fibre.

43. A method according to claim 41, wherein reducing the cane comprises arranging the cane amongst a plurality of rods and/or tubes to form a stack and reducing the stack into the optical fibre.

44. A preform for manufacture into an optical fibre made using the method of any one of claims 20 to 39.

45. An optical fibre made using the method of claim 40, 41 or 42.

46. A preform for manufacture into an optical fibre, comprising a core suspended in an outer wall by a plurality of struts.

47. A preform according to claim 46, wherein the struts have a width dimension smaller than a width dimension of at least one of the outer wall and the core by a factor of at least two.

48. A preform according to claim 47, wherein the factor is at least one of 3, 4, 5, 6, 7, 8, 9 and 10.

49. A preform according to claim 46, 47 or 48, wherein the struts incorporate at least one bend in order to increase their radial length.

50. A preform according to any one of claims 46 to 49, wherein the wall as viewed in cross-section deviates from a circular shape so as to provide wall sections interconnecting wall-to-strut junctions that are shorter than would be required to form a circular-section outer wall.

51. A preform according to any one of claims 46 to 50, wherein the core has a thickness that varies along its axial extent.

52. A preform according to any one of claims 46 to 51, wherein the struts extend helically.

53. A preform according to any one of claims 46 to 52 including at least one further core.

54. A preform according to any one of claims 46 to 53 including at least one integral electrode.

55. A preform according to any one of claims 46 to 54, wherein the struts have a width and a radial length and the radial length is greater than the width.

56. A preform according to claim 55, wherein the radial length of the struts is greater than the width by a factor of one of: 2, 3, 4, 5, 6, 7, 8, 9, 10 and 20.

57. A preform according to any one of claims 46 to 56, made of a glass material.

58. A preform according to any one of claims 46 to 57, made of a polymer material.

59. A preform according to any one of claims 46 to 58, wherein the core is hollow.

60. An optical fibre comprising a core suspended in an outer wall by a plurality of struts.

61. An optical fibre according to claim 60, wherein the struts have a width dimension smaller than a width dimension of at least one of the outer wall and the core by a factor of at least two.

62. An optical fibre according to claim 61, wherein the factor is at least one of 3, 4, 5, 6, 7, 8, 9 and 10.

63. An optical fibre according to any one of claims 60 to 62, wherein the core has a thickness that varies along its axial extent.

64. An optical fibre according to any one of claims 60 to 62 including at least one further core.

65. An optical fibre preform according to any one of claims 60 to 64, wherein the struts extend helically.

66. An optical fibre according to any one of claims 60 to 65 including at least one integral electrode.

67. An optical fibre according to any one of claims 60 to 66, wherein the struts have a radial length greater than at least one of 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18 and 20 micrometers.

68. An optical fibre according to claim 67, wherein the struts have a width smaller than the radial length of the struts by a factor of at least one of 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18 and 20.

69. An optical fibre according to any one of claims 60 to 68, made of a glass material.

70. An optical fibre according to any one of claims 60 to 69, made of a polymer material.

71. An optical fibre according to any one of claims 60 to 70, having a core width of greater than at least one of: 0.3, 0.5, 1, 2 , 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18 and 20 micrometers.

72. An optical fibre according to any one of claims 60 to 71, wherein the core is hollow.

73. A method of manufacturing a microstructured optical fibre comprising:

forming by extrusion a preform comprising a core suspended in an outer wall by a plurality of struts; and

reducing the preform into an optical fibre.

74. A laser, amplifier, non-linear device, switch, acousto-optic, sensor or other optical device comprising optical fibre according to any one of claims 60 to 72.